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CLINICAL OUTCOME OF TIBIA INTRAMEDULLARY NAILING USING SUPRAPATELLAR PORTAL

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Abstract:

Background : Suprapatellar tibial nailing in the semiextended position has emerged as a safe and effective surgical technique that allows overcoming certain challenges faced with other intrapatellar and parapatellar approaches.

Method: This prospective study was carried out on 34 patients who sustained extraarticular tibial fracture. Intramedullary tibial nailing via suprapatellar approach was accomplished. Results were evaluated using the Johner and Wruh's Criteria which includes both the clinical and the radiological assessment of the patient.

Result: 30 patients were followed up upto 6 months. Excellent results in accordance with Johner and Wruh's Criteria were seen in 7 patients. Good results were seen in 20 patients. One patient had varus angulation more than 50. None of the patient developed nonunion or osteomyelitis.

Conclusion: Intramedullary tibia nailing via suprapatellar approach is an efficient and convenient treatment for selected tibial fractures, with less postoperative knee joint pain, fewer postoperative complications and early functional recovery.

Keywords: *Clinical Outcome, Tibia Intramedullary Nailing, Suprapatellar Portal*

Introduction

Tibial shaft fractures representing a relatively common injury, are typically encountered in young patients and they usually result from high-energy trauma.¹ The incidence of tibial shaft fractures is reported as between 16 to 21 per 100,000 persons representing 2% of all fractures and up to 40% of all long bone fractures in adults.² Closed fractures of the tibial shaft are most common, and reported with a frequency between 76.5% and 88.0% of all tibial shaft fractures.^{3,4}

Intramedullary nailing has become the gold standard treatment option for displaced closed or open (Gustilo Anderson Grade I-II^o) tibial diaphyseal fractures.⁵⁻⁸ Intramedullary nailing acts as an internal splint and permits early weight bearing along with fracture healing.⁹ Intramedullary nail fixation provides the advantage of minimal surgical dissection with preservation of the extraosseous blood supply to the fracture.

Multiple routes have been developed for intramedullary nailing of tibia, most common of which is the infrapatellar (including transtendinous, medial paratendinous, lateral paratendinous) route. A major side effect of tibial nailing after infrapatellar route is postoperative anterior knee pain, with a mean incidence of 47% after 2 year.¹⁰ In particular, postoperative knee pain seems to be a limiting factor during the recovery process.¹¹ Insertion of the nail through the patella tendon in transpatellar approach was associated with a higher incidence of knee pain compared to the paratendon site of nail insertion.¹² This can be due to the incision through the tendon in transpatellar approach causing retro-tendinous fat pad-injury, which is highly innervated. When parapatellar

approach is used, the patellar tendon, the retropatellar fat pad and the tissues are retracted and, theoretically there would be no tissue injury.¹³⁻¹⁵

Recent advances in nail design and reduction techniques have expanded the indications for intramedullary nail fixation to more proximal as well as more distal tibia fractures involving the metaphyseal area. Techniques have been developed to insert the nail through a semi-extended suprapatellar approach to facilitate intraoperative imaging, allow easier access to starting site position, and counter deforming forces.

Suprapatellar approach of tibial nailing in the semi-extended position has recently been suggested as a safe and effective surgical technique and has recently gained significant attention in the orthopaedic literature.¹⁶ This technique in the semiextended position offers several potential advantages. The semiextended leg position potentially facilitates the fracture reduction particularly in proximal third tibial fractures with the typical apex anterior deformity. In these injury patterns, hyperflexion of the knee (in infrapatellar approach) over the radiolucent triangle may exaggerate the existing apex anterior deformity. In contrast, the semiextended position may eliminate the extension force of the quadriceps neutralizing the deforming forces and may greatly facilitate the reduction of the apex anterior angulation.¹⁷

The main benefit of intramedullary nailing in semiextended position is that it improves postoperative fracture alignment.¹⁸ Perfect fracture reduction can be achieved in nearly every case by positioning the extremity in slight flexion. Maintenance of fracture reduction and radiographic imaging control is simplified with

this technique. Jones et al showed significantly better reductions and more accurate starting points in the suprapatellar approach. Preliminary clinical data have shown promising results with a low rate of postoperative anterior knee pain. Suprapatellar route changes the access route and avoids a close relationship with the patellar tendon. Lesions of this tendon at different levels are associated with knee pain after implantation of an intramedullary nail. Because suprapatellar route does not injure the tendon, it consequently leads to lower levels of chronic knee pain after implant placement, or even absence of pain.¹⁹

In this study, suprapatellar approach for tibia intramedullary nailing has been used for tibia shaft fractures to evaluate the clinical outcome of the patients undergoing treatment. This technique is generally done for proximal one third tibial shaft fractures that are more prone to anterior apex deformity. In this study, we have extended its indication to include all fractures of tibial shaft and also the proximal and distal tibial metaphysis.

Material And Methods

The informed consent was obtained from all the patients to participate in the study. The present study has been approved from ethical committee of our hospital. Inclusion criteria: (i) Tibial shaft fractures suitable for intramedullary nailing. (ii) Skeletal maturity (iii) Closed and open (Grade I and II Gustilo Anderson classification) tibia fractures. The exclusion criteria were: (i) Tibia shaft fractures with significant articular extension (ii) Open (grade III Gustilo Anderson classification).

34 patients (27 males and 7 females) were enrolled in this study which was conducted from august 2015 to May 2017 in Department of Orthopaedics, Sri Guru Ram Das Institute of Medical Science and Research, Amritsar. These patients underwent tibia fixation with intramedullary interlock nailing via suprapatellar approach. Out of the 34 patients, 7 had proximal 1/3rd fractures, 10 had midshaft fractures (including 2 segmental fractures) and 17 had distal 1/3rd fractures (including 2 segmental fracture). 30 patients were followed up for a period of 6 months.

Operative Technique

The patient is positioned supine on a radiolucent table, and the injured leg is positioned with a roll under the knee joint so that it is flexed 20-30 degrees. A 1.5-cm to 2-cm longitudinal skin incision is made 1cm above the base of the patella. The quadriceps tendon is exposed and a longitudinal midline split is performed in the tendon. For optimal entry, it should be possible to run a finger easily under the patella and into the knee joint. The patella can be subluxated to one side, or can be elevated enough for instrumentation. Next, the starting point is established under fluoroscopic guidance with a 3.2-mm guide pin, respecting the anatomic landmarks. The guide pin is inserted from superior aspect and behind the patella to make the desired entry point.

When the correct position of the guide wire is verified by radiographic imaging in both anteroposterior and lateral views, the protection sleeve is inserted. With a blunt trocar, the sleeve can be carefully rolled over the guide wire and in under the patella to the top of the tibia. It is important to ensure under fluoroscopy that the sleeve

“sits” on top of the tibia to prevent iatrogenic damage to the knee joint. It is important that sleeve’s location is regularly checked during the reaming process.

The reaming process is performed through the cannula system, allowing for appropriate protection of the surrounding soft tissues and intra-articular structures. The nail insertion process requires the proximal jig with a long handle. The reaming process, nail insertion followed by distal and proximal locking is similar to the conventional intramedullary nailing. The postoperative treatment protocol is identical to established protocols of tibial nailing, and early range of motion exercises of the knee and ankle are encouraged.¹⁷

Results

Results were evaluated using the Johner and Wruh’s Criteria.⁵⁷ This criteria includes both the clinical and the radiological assessment of the patient. Based on this assessment, the patients were graded as poor, fair, good or excellent. Out of the 34 patients, 4 patients were lost to follow up. 30 patients were followed up for a period of 6 months. Radiographs showed callus at the fracture site in nearly all the patients with average of 8 weeks postoperatively. One patient had superficial infection which was treated with oral antibiotics. There were no nonunion and osteomyelitis. Excellent results in accordance with Johner and Wruh’s Criteria were seen in 7 patients. Good results were seen in 20 patients.

Table showing the final grading of the patients according to johner and wruh criteria

Grading Of Patients	Number Of Cases	Percentage
Excellent	7	23.33%
Good	20	66.67%
Fair	3	10%
Poor	0	0%
Total no. of cases	30	100%

Functional Assessment (Johner And Wruh’s Criteria)

	Excellent	Good	Fair	Poor
Non Union, Osteomyelitis, Amputation	None	None	None	Yes
Neurovascular Disturbances	None	Minimum	Moderate	Severe
Deformity				
V algus/Varus (Degrees)	None	2°-5°	6°-10°	>10°
Anteversion/Recurvatum (Degrees)	0-5°	6°-10°	11°-20°	>20°
Rotation (Degrees)	0-5°	6°-10°	11°-20°	>20°
Shortening (millimetres)	0-5 mm	6-10 mm	11-20 mm	>20 mm
Mobility				
Knee Joint (%)	Normal	>80%	>75%	<75%
Ankle Joint (%)	Normal	>75%	>50%	<50%

Subtalar Joint (%)	>75%	>50%	<50%	-
Anterior Knee Pain	None	Occasional	Moderate	Severe
Gait	Normal	Normal	Insignificant Limp	Significant Limp
Strenuous Exercises	Possible	Limited	Severely Limited	Impossible
Number Of Cases	7	20	3	0

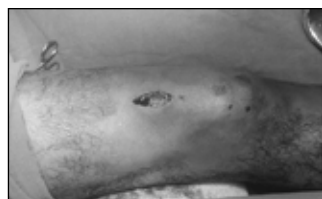


Figure showing longitudinal midline incision



Figure showing insertion of protection sleeve for reaming process



Preoperative X ray



Immediate Postoperative X ray



Postoperative X ray After 6 months

Discussion

Suprapatellar approach to tibia nailing has emerged as a safe and efficient technique with a wide range of indications and as an alternative to the traditional infrapatellar approach. With suprapatellar nailing, it has become simpler to perform nailing of proximal tibial fractures. The indications for this technique are far more extensive, and it can also be used advantageously for tibial shaft fractures and distal metaphyseal fractures. The main advantages of this approach are the simple positioning of the patient and the injured leg in semi extended position, which simplifies reduction of the fracture, thus causing ease during the surgery procedure. In this study 29 patients achieved satisfactory fracture reduction except for one having varus angulation $> 5^\circ$. There was no loss of fracture reduction and displacement during the follow up.

These favourable results could be due to the fact that the semiextended leg position in suprapatellar approach potentially facilitates the fracture reduction particularly in proximal

third tibial fractures with the typical apex anterior deformity by eliminating the extension force of the quadriceps and by mitigating the deforming forces around the knee encountered with flexion.¹⁷ In infrapatellar approach while making the entry point, the guide wire is pushed towards the posterior cortex which accentuates the apex anterior deformity. Patella can be subluxated in either direction providing no hinderance to the entry point in the semiextended position. suprapatellar approach helps in maintaining reduction and fracture alignment not only in proximal third fractures but in diaphyseal and distal third fractures also.

The semiextend position also allow to control the rotation and angulation with the affected limb. Besides the application of an image intensifier machine combined with blocking screws also facilitate fracture reduction and fixation during surgery. The infrapatellar nerve is well protected and not at risk of injury when using this approach. Additionally, soft tissue scar formation will not be located on the anterior knee, but rather superior to the patella, which may reduce flexion-related pain and pain with kneeling. Splitting the quadriceps tendon causes scar tissue to form superior to the patella which may reduce flexion-related pain or kneeling pain.²¹

Avilucea FR et al concluded that in the treatment of distal tibia fractures, suprapatellar intramedullary nailing technique results in a significantly lower rate of malalignment compared with the infrapatellar intramedullary nailing technique.²² Qi Sun et al compared the outcome of suprapatellar and infrapatellar approaches for the tibia intramedullary nailing and concluded that the suprapatellar approach was superior to infrapatellar

approach for the treatment of tibia shaft fracture.²³ Jones M et al concluded that retropatellar tibial nail insertion was not associated with more anterior knee pain when compared with infrapatellar nail insertion but was associated with more accurate nail insertion and fracture reduction.¹⁹

However, there certainly remains the concern of iatrogenic damage to structures of the patellofemoral joint as the instruments have to be placed across this joint. A major aspect of the suprapatellar approach is transarticular nail insertion. Using a cadaver model, Gelbke et al measured the contact pressures in the patellofemoral joint during suprapatellar nailing in the semiextended position versus infrapatellar nailing. These authors reported higher peak pressures with the suprapatellar nailing technique. However, the authors also reported that the observed peak pressures were well below the threshold that has been reported to be detrimental to articular cartilage and they concluded that suprapatellar nailing in the semiextended position represents a safe surgical technique.²⁴

Gaines et al. reported a low incidence of intraarticular complications in the management of tibia fractures using suprapatellar approach.²⁵ Jakma *et al.* noticed partial cartilage injury in femoral trochlea with arthroscopy in suprapatellar intramedullary nailing for seven patients with tibia proximal fracture and none of patients complained of knee pain at the follow up after surgery.²⁶ Chan et al conducted a study to compare the clinical and functional outcomes of the knee joint after infrapatellar (IP) versus suprapatellar (SP) tibial nail insertion. No patient in the suprapatellar group with postnail insertion arthroscopic changes had

patellofemoral joint pain at 1 year.²⁷

Several limitations of our study must be addressed. First, the number of the cases included in the study and followup period was small. Second, the status of cartilage over patella and trochlea post surgery has not been evaluated. Thus, further prospective studies with large population and long follow up time were required to compare the clinical outcomes of tibial fractures after locked intramedullary nailing via suprapatellar and infrapatellar approaches.

Conclusion

Intramedullary nailing through Suprapatellar approach is an excellent and convenient surgical technique for extraarticular tibial fractures and a good clinical and radiological outcomes can be achieved using this approach.

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